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To cite this article: O S Burukhina *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **753** 042071

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Comprehensive Approach to Multi Comfort Urban Space Design in High-Density of Milan Development

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Abstract. Relevance of the research is conditioned by the necessity to search for a new model of urban planning formation of housing estates in the constrained conditions of already established cities. With the modern cities' expansion, investors, urban planners, architects and developers face a difficult task to develop urban areas that are in a dense ring of buildings and structures. Herein it should consider that large cities require multicomfortable apartment buildings, although they are in high-density areas. This paper represents the results of project work upon a social residential complex that meets the criteria of energy efficiency and multi-comfort in high-density development of the Crescenzago district (Milan, Italy). The project is based on the principles of eco-certification according to the BREEAM standard. As part of the project, to ensure the sustainable development of the territory under consideration, climatic, urban, social and cultural factors were analyzed; urban planning and architectural concepts of the site development, as well as constructive and engineering solutions for residential multi-apartment buildings have been created. The paper provides the author's design solution for a complex of residential buildings, organically integrated into the existing urban space development. This is a qualitatively new residential development format that meets all modern requirements for providing thermal, visual, acoustic comfort, safety standards, as well as the concept of sustainable development..

1. Introduction

The world's largest cities keep developing and growing. Highly dense development is common for many European metropolitan areas. Such cities include Milan (Italy), where it is planned to build-up a residential area near Crescenzago metro station.

Milan has a humid subtropical climate typical for the northern Italian plains, with warm hot summers and cold foggy winters, with low rainfall days per year.

Nowadays Milan encounters a new stage of growth, where the number of the youngest population and pensioners increases the fastest. According to the development program drawn up by the Milan Municipality, the Crescenzago area should become a zone with a quality public space, extensive infrastructure, green areas and essential elements for everyday life.

The design area is a 135x105 m building plot in the area of Crescenzago Milan, Italy (figure 1).



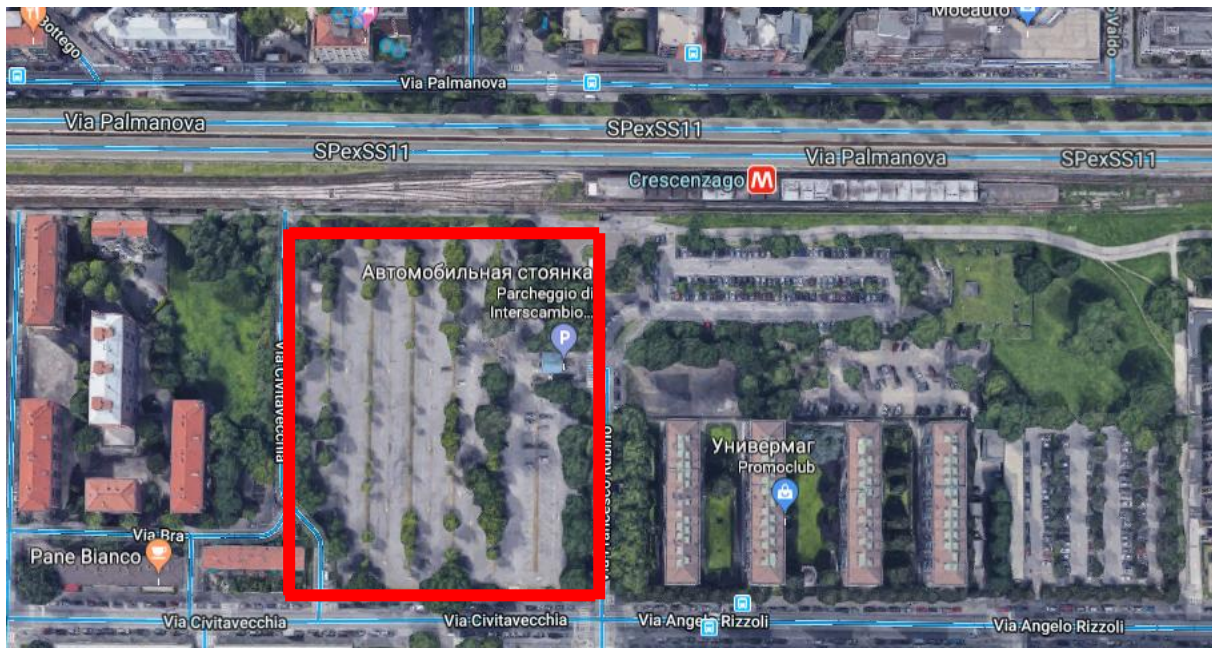


Figure 1. The building plot under consideration.

For the present near design area there is a large amount of social housing built in the 1970s-1980s. As well as the metro station of the same name on the one side, and on the other side the modern complex "Green Skyscrapers," office buildings and a shopping centre.

This plot has a good transport infrastructure providing easy access to the city center to residents; from the north-west of the plot there is a subway line, from the south-east there is a dedicated lane of public transport. Also it is appeared a decrease in the number of storeys from northwest to south-east due to green areas on the southern side.

Social infrastructure in the Crescenzago area is underdeveloped, namely, schools and kindergartens are located at a distance of 2.5-3 km from the site under consideration, with a norm of 300-500 m.

Therefore, when designing a new urban area it is necessary to pay special attention to the creation of quality urban space corresponding to the sustainable development of the territories. To assess the quality of life of the residents and the compliance of buildings with sustainable development criteria, various systems of eco-certification of buildings are used. The BREEAM standard [1] is the leading British standard and account urban, architectural and technical design fields. Currently, it is used in various modifications in more than 80 countries to certify residential and commercial real estate [2-4].

In accordance with the BREEAM standard [1, 5], the following main objectives were set for the design of social housing:

- Creating a multi-comfortable and safe multifunctional space for future residents of the site;
- Situating 300 apartments on the plot with up to 5 storeys of houses for different social groups;
- Choosing of quality energy efficient construction materials available at the region;
- Building envelope design accounting the requirements of heat protection and airtightness.

2. Urban planning solution

On the given plot, according to the terms of reference, a medium-rise high-density building is designed, provided a comfortable human-scaled environment, as well as does not contradict the already established architectural style of the area [6-8].

Only pedestrians, cyclists and special-purpose machinery have an access to the residential area (figure 2). The entrance to the underground parking is located from the outer streets of the building. Thus, only one driveway leads inside, which provides a safe closed area with preservation of fire

safety requirements. The fire driveway has a special rubberized surface for the special machinery traffic in case of emergencies and comfortable stay of pedestrians.

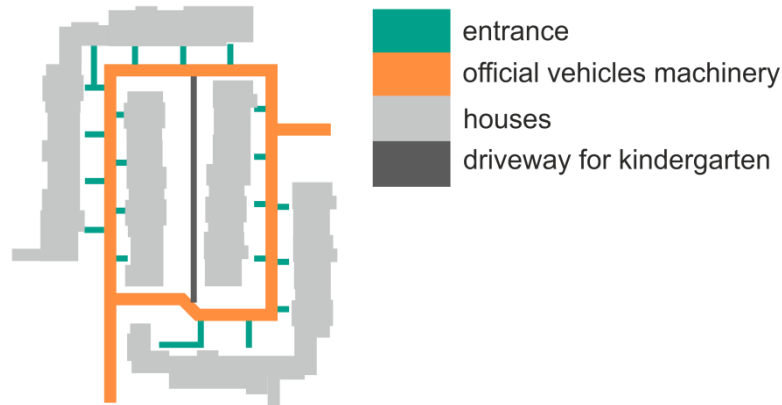


Figure 2. Scheme of transport and pedestrian routes on the plot.

Buildings are of 5 storeys and located at least 10 m away from each other to organize a green adjacent space and provide the necessary width of the road for the access of special machinery. It also allows the eye to defocus, which is important for maintaining healthy vision [1, 7]. On the ground floor of the two corner houses there are shops and office spaces, and on the ground floor of the central houses there is a kindergarten for 100 children.

Public areas of various purposes (playgrounds and sports grounds, areas of quiet rest) are located on the roof to increase the useful space of the site. It is available for all residents and their guests.

The territory of underground parking occupies 4500 m² with a bicycle parking area of 450 m².

3. Architectural and planning solution of the residential complex

Before designing the apartment buildings, the social composition of future residents was analyzed. Figure 3 shows the results.

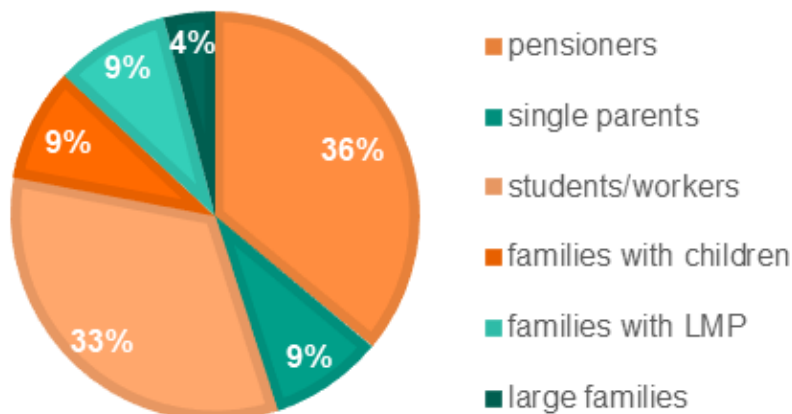


Figure 3. Social composition of residents.

Section-type houses were designed for optimal accommodation. Compositionally the apartments in the sections are located in such a way as to strengthen the interaction between social groups of approximately the same age and similar lifestyle and avoid possible conflicts. Five types of sections have been developed as figure 4 represents.

Brick masonry, white plaster and glazing are chosen as finishing as figure 5 shows. The brick finished of the ground floor corresponds to the common terracotta color of the residential building in Milan, white plaster and a large amount of glazing refers to the office building in the south of the plot. Thus, the new houses are harmoniously fit into the existing development.

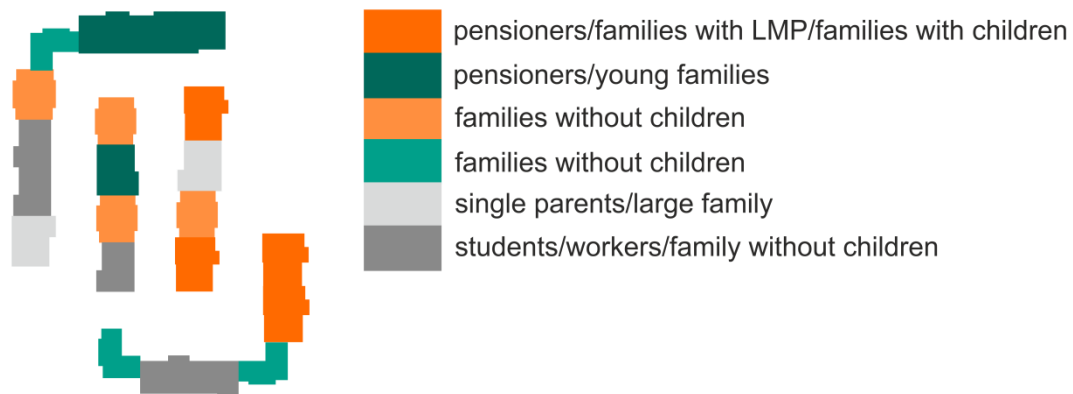


Figure 4. Section layout.



Figure 5. Building facade solution.

4. Design solution and engineering systems

The building has a frame structural system, provided flexibility of space and easiness of remodeling.

The project uses materials of Saint-Gobain Group, including Isover thermal insulation materials, Sage Glass glazing, Gyproc plasterboard partitions, steam and waterproofing with preservation of traditional Italian construction technology [9-11]. All used materials have a A2 degree of fire safety. Also, the materials provide the most comfortable acoustic environment, what is especially important in the context of acoustic comfort [12] with the metro near the plot. Construction joints comply with Passive House standards. These design solutions provide thermal comfort and meet the requirements of air tightness, which is necessary for the qualitative ventilation systems. The tightness is ensured by the internal plastering of the brick wall, the concrete coating and the ceiling above the basement. According to the results of the thermal calculation in a Multi Comfort Designer program, the building is energy efficient of A class, with annual energy consumption for heating less than 10 kWh/m².

A natural ventilation system based on the principle of climatic cascade employs at the project. The main advantage of the system is an absence of noise, energy saving and comfortable temperature of the incoming air. The natural ventilation system also includes heat and waste water recuperators, returning at least 75% of the heat back into the house.

4.1. Energy Efficiency and Resource Saving Activities

The energy system of the residential complex includes solar panels located on the courtyard gazebos performed two functions. During the day the gazebos create a shadow and the solar panels accumulate energy, in the evening they work as a lantern (figures 6, 7).



Figure 6. Courtyard during the day.

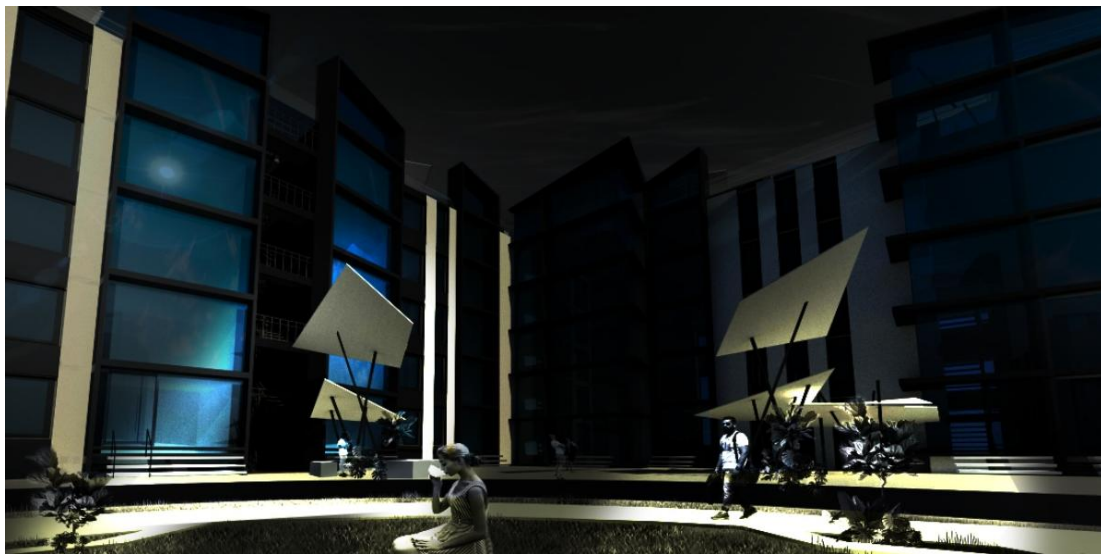


Figure 7. Courtyard at night.

In addition to renewable energy sources, the project includes innovative waste treatment plant developed by MISIS University and NORD. The plan generates electricity from waste with no harmful emissions into the atmosphere. The capacity of such a mini-factory is sufficient to generate electricity for the residential complex and even neighboring houses.

Medium-storey high-density development makes it possible to use the plot as intensively as possible in terms of ecology, health, economy, security and social interaction. High density reduces the cost of housing, utilities, and helps to develop the business on or near the site [13, 14].

These measures contribute to the formation of a creative attitude to nature, a habit of moderate consumption of resources [14-16].

5. Conclusion

This article is devoted to the practice of designing energy-efficient multi-comfortable social housing in the densely built-up urban area of Crescenzago (Milan), taking into account BREEAM standards. Within the framework of this project, the authors analyzed the BREEAM building certification system with regard to life safety, environmental impact and comfort. The authors managed to place all the necessary infrastructure facilities, such as retail space, kindergarten, parking for cars and bicycles, as well as a green recreation area on the roof. It is possible with high-density development saving natural and anthropogenic resources and at the same time connects the entire urban structure into a single whole. In addition, the recommendations of the standard are taken into account to ensure the sustainable development of the area in accordance with the city development program. The project uses modern materials and equipment, implements innovative energy-efficient technologies that allow not only to reduce energy consumption for heating and ventilation, but also to generate additional energy, for example, to illuminate the courtyard. The project of this social housing complex can become an excellent example of creating a qualitatively new standard that meets all relevant requirements.

References

- [1] BREEAM 2016 BREEAM International New Construction Technical Manual p 568
- [2] Kubba S 2012 Handbook of green building design and construction: LEED, BREEAM, and Green Globes. (Butterworth-Heinemann) p 820
- [3] Awadh O 2017 Sustainability and green building rating systems: LEED, BREEAM, GSAS and Estidama critical analysis *Journal of Building Engineering* **11** pp 25-29
- [4] Maltceva I N, Rybakova A O and Maltceva K V 2017 *SAFETY2017* (Ekaterinburg) pp 767-778
- [5] Lee W L, and Burnett J 2008 Benchmarking energy use assessment of HK-BEAM, BREEAM and LEED *Building and Environment* **43** pp 1882-1891
- [6] Boeri A and Longo D 2012 High density suburbs redevelopment and social housing retrofitting for cities regeneration *The Sustain City VII Urban Regener Sustain* **155** pp 133-144
- [7] Jenks M and Colin J 2009 *Dimensions of the sustainable city* (Springer Science & Business Media)
- [8] Chereshevnev I V 2006 *Environmental aspects of the formation of low-rise residential buildings for urban development of high density* (St.-Petersburg: Lan)
- [9] Asdrubali F, Francesco D'A, and Schiavoni S 2015 A review of unconventional sustainable building insulation materials *Sustainable Materials and Technologies* **4** pp 1-17
- [10] Godfaurd J, Clements-Croome D, and Jeronimidis G 2005 Sustainable building solutions: a review of lessons from the natural world *Building and environment* **40** pp 319-328
- [11] Li D H, Yang L and Lam J C 2013 Zero energy buildings and sustainable development implications—A review. *Energy* **54** pp 1-10
- [12] Markelj J, Kuzman M K, Grošelj P and Zbašnik-Senegačnik M 2014 A simplified method for evaluating building sustainability in the early design phase for architects *Sustainability* **12** pp 8775-8795
- [13] Hui S C M 2001 Low energy building design in high density urban cities *Renewable energy* **24** pp 627-640
- [14] Resch E, Bohne R A, Kvamsdal T and Lohne J 2016 Impact of urban density and building height on energy use in cities *Energy Procedia* **96** pp 800-814
- [15] Akhremenko S A and Viktorov D A 2014 *Features of urban design* (Moscow: ASV)
- [16] Gasho E G, Koval A V and Postelnik M I 2004 An integrated approach and logistics of the territorial energy economy: the unity of technical, organizational, economic and information solutions (Moscow)